CHEMISTRY

JEE MAIN AND ADVANCED

COORDINATION COMPOUNDS

Example

1. What is the coordination entity formed when excess of aqueous KCN is added to an aqueous solution of copper sulphate? Why is it that no precipitate of copper sulphide is obtained when H_2S (g) is passed through this solution?

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2. $K_2[PtCl_6]$ is ionized to three ions when dissolved in water . Will it give white precipitate with $AgNO_3$ solution ?

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3. What is chelating ligand ?

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4. Write the formulas for following coordination compounds :

(1) Tris (ehtane -1,2-diammine) cobalt (III) sulphate

(2) Potassiumtrioxalatoaluminate(III)

(3) Hexacaronylchromium (0)

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5. Write IUPAC names of following compounds :

(1) $\left[Co(NH_3)_5(CO_3)\right]Cl$

(2) $Hg\left[Co(SCN)_4\right]$

(3) $\left[Pt(NH_3)_2Cl(NO_2)\right]$

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6. Name the type of isomerism exibited by the following isomers :

(1)

$\left[Cr(NH_3)_6\right]\left[Cr(CN)_6\right]$ and $\left[Cr(NH_3)_4(CN)_2\right]\left[Cr(NH_3)_2(CN)_4\right]$

(2) $\left[Co(py)_2(H_2O)_2Cl_2\right]Cl$ and $\left[Co(py)_2(H_2O)Cl_3\right]H_2O$

(3) $\left[Pt(NH_3)_4Br_2\right]Cl_2$ and $\left[Pt(NH_3)_4Cl_2\right]Br_2$

(4) $\left[Co(NH_3)_5NO_2\right]Cl_2$ and $\left[Co(NH_3)_5ONO\right]Cl_2$

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7. Platinum (II) forms square planar complexes and platinum (IV) gives octahedral complexes . Describe the structures of geometrical isomers of following compounds :

(1) $\left[Pt(NH_3)_3Cl\right]^+$ (2) $\left[Pt(NH_3)Cl_5\right]^-$

(3) $\left[Pt(NH_3)_2ClNO_2\right]$ (4) $\left[Pt(NH_3)_4ClBr\right]^{2+}$

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8. How would you account for the magnetic behaviour of $\left[Fe(CN)_6\right]^{3-}$ and $\left[Fe(CN)_6\right]^{4-}$?

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9. Arrange the following complexes in order of increasing crystal field splitting .

$\left[Fe(H_2O)_6\right]^{2+}, \left[Fe(H_2O)_6\right]^{3+}, \left[FeCl_6\right]^{4-}$.

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10. What is the coordination number of Mn in $\left[Mn_2(CO)_{10}\right]$?

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11. Calculate the instability constant for $\left[Ni(NH_3)_6\right]^{2+}$, given that β_6 for this complex is 2×10^{12}

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12. Calculate EAN of central atom/ ion in

(1) $K_4\left[Fe(CN)_6\right]$

(2) $\left[Co(en)_2(NH_3)_2\right]^{3+}$

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13. Which of the two compounds are more stable and why . $K_4\left[Fe(CN)_6\right], K_3\left[Fe(CN)_6\right]$?

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Try Yourself

1. What is the coordination number of Co in $\left[Co(NH_3)_4(H_2O)Br\right](NO_3)_2$?

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2. What is the oxidation number of Fe in $K_3\left[Fe(C_2O_4)_3\right]$?

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3. On the basis of the following observations made with aqueous solutions , assign primary and secondary valencies to metals in the following compounds .

Formula	Moles of AgCl precipitated per mole of compound with excess $AgNO_3$
$PdCl_2 \cdot 4NH_3$	2
$NiCl_2 \cdot 6H_2O$	2
$PtCl_4 \cdot 2HCl$	0
$CoCl_3 \cdot 4NH_3$	1
$PtCl_2 \cdot 2NH_3$	0

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4. Which of the following are chelating ligands ?

$H_2O, C_2O_4^{2-}, EDTA^{4-}, CO_3^{2-}, CO, C_2H_4$

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5. Are the bidentate ligands same as the ambidentate ligands ?

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6. Write the formulas for the following coordination compounds :

(1) Diamminesilver (I) chloride

(2) Potassiumtetraiodomercurate(II)

(3) Iron(III) hexacyanoferrate(II)

(4) Amminebromidochloridonitrito-N-platinate(II)

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7. Write the IUPAC names of the following coordinates compounds :

(1) $\left[Co(NH_3)_5Cl\right]Cl_2$

(2) $K_2[PdCl_4]$

(3) $\left[Cr(H_2O)_4Cl_2\right]^+$

(4) $K_3\left[Fe(CN)_5NO\right]$

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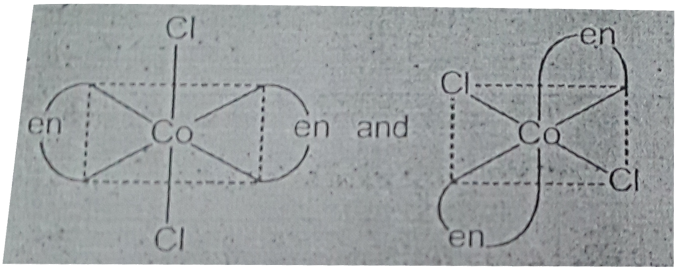
8. Are the following two compounds optical isomers ?



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9. Give evidence to show that $\left[Co(NH_3)_5Cl\right]SO_4$ and $\left[Co(NH_3)_5SO_4\right]Cl$ exist as ionisation isomers.

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10. Predict the hybridisation and geometry of $[CoCl_4]^{2-}$ and $[Co(CN)_4]^{2-}$

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11. Explain $[Co(NH_3)_6]^{3+}$ is an inner orbital complex whereas $[Ni(NH_3)_6]^{2+}$ is an outer orbital complex.

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12. $[Fe(H_2O)_6]^{3+}$ is strongly paramagnetic whereas $[Fe(CN)_6]^{3-}$ is weakly paramagnetic. Explain.

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13. Explain why hexacayano complexe of metals in their +2 oxidation state are usually yellow , but the corresponding hexa aqua compounds are often blue or green .

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14. Which of the following is more stable ?

(1) $K_4\left[Fe(CN)_6\right]$ or $K_3\left[Fe(CN)_6\right]$

(2) $\left[Co(NH_3)_6\right]^{3+}$ or $\left[Co(en)_2(NH_3)_2\right]^{3+}$

(3) $[NiCl_4]^{2-}$ or $\left[Ni(CN)_4\right]^{2-}$

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Assignment Section A Objective Type Questions One Option Is Correct

1. The complex $K_3\left[Fe(CN)_6\right]$ furnishes

A. 2 ions

B. 3 ions

C. 4 ions

D. 5 ions

Answer: C

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2. Total number of electrons donated by ligands to platinum ion in $\left[Pt(en)_2Cl_2\right]$ is

A. 8

B. 10

C. 12

D. 14

Answer: C

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3. The IUPAC name of $\left[Ni(CN)_4\right]^{2-}$ is

A. Tetracyanonickel (II) ion

B. Tetracyanonickelate (II) ion

C. Tetracyanonickel (O) ion

D. Tetracyanonickelate (O) ion

Answer: B

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4. Out of following which ligand is a π acid ligand ?

A. CO

B. NH_3

C. Cl^-

D. H_2O

Answer: A

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5. The co-ordination number of Co in $\left[Co(C_2O_4)_2Cl_2\right]$ is

A. 4

B. 6

C. 8

D. 12

Answer: B

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6. Which of the following is not an ambidntate ligand ?

A. CN^-

B. NO_2^-

C. SCN^-

D. NH_3

Answer: D

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7. Primary and secondary valencies of Cu in $\left[Cu(NH_3)_4\right]SO_4$ is

A. 4,4

B. 2,4

C. 4,1

D. 4,2

Answer: B

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8. IUPAC name of $K[BF_4]$

A. Potassium tetrafluoroborate

B. Tetrafluoroboron (III) potassium

C. Potassiumtetrafluoridoborate (III)

D. Tetrafluoridoboron (III) potassium

Answer: C

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9. Oxidation number of plantinum in cis-platin

A. Zero

B. $+2$

C. $+4$

D. $+6$

Answer: B

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10. Aq. solution of of $KCl \cdot MgCl_2 \cdot 6H_2O$ will give test of

A. K^+ and Mg^{2+} only

B. K^+ and Cl^- only

C. K^+, Mg^{2+} and Cl^-

D. Mg^{2+} and H_2O only

Answer: C

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11. Which of the following complex is homoleptic ?

A. $H_2[PtCl_6]$

B. $Li[AlH_4]$

C. $[Ni(CO)_4]$

D. All of these

Answer: D

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12. Aqueous solution of $CoCl_3 \cdot 6NH_3$ upon addition with $AgNO_3$ produces 3 moles white precipitate . Primary and secondary valency of metal in this complex is

A. 3,6

B. 2,6

C. 3,3

D. 6,4

Answer: A

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13. Structural formula of tetraaquadichloridochromium(III) chloride

A. $\left[(H_2O)_4Cl_2Cr\right]Cl$

B. $\left[Cl_2(H_2O)_4Cr\right]Cl$

C. $\left[Cr(H_2O)_4Cl_2\right]Cl$

D. $\left[Cr(H_2O)_4Cl_3\right]$

Answer: C

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14. Which of the following is neutral coordination sphere ?

A. $K_4\left[Fe(CN)_6\right]$

B. $\left[Co(NH_3)_6\right]Cl_3$

C. $\left[Pt(NH_3)_2Cl_2\right]$

D. $\left[Cu(NH_3)_4\right]SO_4$

Answer: C

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15. Which of the following is not a polydentate ligand ?

A. Oxalate ion

B. Ethylenediamine

C. Thiocyanato

D. EDTA

Answer: C

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16. Find the incorrect statement about EDTA

A. It is anionic ligand

B. It is a chelating ligand

C. It is a flexidentate ligand

D. Four coordinating sites are present in it

Answer: D

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17. The complex $\left[Cr(H_2O)_5Cl\right]Br$ and $\left[Cr(H_2O)_5Br\right]Cl$ show

A. Linkage isomerism

B. Ionisation isomerism

C. Hydrate isomerism

D. Co-ordination isomerism

Answer: B

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18. Which of the following octahedral complexes do not show geometrical isomerism ?

A. $\left[Co(NH_3)_3Cl_3\right]$

B. $\left[PtCl_2(NH_3)_4\right]$

C. $\left[Cr(H_2O)_5Cl\right]^{2+}$

D. $\left[Co(en)_3\right]^{3+}$

Answer: C

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19. The number of geometical isomers possible for a square planar complex $[MABCD]^{\pm n}$ are

A. 2

B. 3

C. 4

D. 5

Answer: B

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20. Coordination isomerism exhibited by

A. $\left[Cr(en)_2Cl_2\right]NO_2$

B. $\left[Co(NH_3)_5Br\right]SO_4$

C. $\left[Pt(NH_3)_4\right]\left[CuCl_4\right]$

D. $\left[Co(NH_3)_5Cl\right]Cl_2$

Answer: C

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21. Which one of the following complexes will have six isomers ?

A. $[Co(en)NH_3Cl_2]Cl$

B. $\left[Cr(PPh_3)_2(H_2O)_2Cl_2\right]Cl$

C. $\left[Co(ox)_3\right]^{3-}$

D. $\left[Co(en)_2Br\right]Cl$

Answer: D

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22. Which of the following does not show optical activity ?

A. $\left[Co(NH_3)_4Cl_2\right]$

B. $\left[Cr(ox)_3\right]^{3-}$

C. $\left[Co(ox)_2(NH_3)_2\right]Cl$

D. $\left[Co(en)(NH_3)_2(H_2O)_2\right]Cl_2$

Answer: A

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23. How many isomers are possible in $\left[Cr(en)_2Br_2\right]$?

A. 2

B. 3

C. 6

D. 1

Answer: B

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24. The hybridisation of Ni in $\left[Ni(CO)_4\right]$ is

A. sp^3

B. dsp^3

C. sp^2

D. sp^3d

Answer: A

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25. Which of the following is/are inner orbital complex ?

A. $\left[Fe(CN)_6\right]^{4-}$

B. $\left[Cr(NH_3)_6\right]^{3+}$

C. $\left[Mn(CN)_6\right]^{3-}$

D. All of these

Answer: D

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26. Which one of the following is paramagnetic in nature ?

A. $Ni(CO)_4$

B. $\left[Ni(CN)_4\right]^{2-}$

C. $K_4\left[Fe(CN)_6\right]$

D. $[FeF_6]^{4-}$

Answer: D

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27. Number of unpaired electrons present in $\left[Ni(H_2O)_6\right]^{2+}$

A. Two

B. One

C. Four

D. Three

Answer: A

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28. The spin magnetic moment of iron in $K_3\left[Fe(CN)_6\right]$

A. $\sqrt{3}BM$

B. $\sqrt{5}BM$

C. $\sqrt{15}BM$

D. $\sqrt{24}BM$

Answer: A

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29. $\left[Fe(H_2O)_6\right]^{3+}$ and $\left[Fe(CN)_6\right]^{3-}$ differ in

A. Oxidation number

B. Coordination number

C. Structure

D. Magnetic nature

Answer: D

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30. The spin only magnetic moment of $[MnBr_4]^{2-}$ is 5.9 B.M. Geometry of the complex ion is

A. Tetrahedral

B. Octahedral

C. Square planar

D. Pentagonal pyramidal

Answer: A

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31. In the formation of octahedral complex , ligands approach towards _____ and _____ orbital of central metal

A. $d_{xy}, d_{x^2-y^2}$

B. $d_{x^2-y^2}, d_{z^2}$

C. d_{xy}, d_{yz}

D. d_{z^2}, d_{xz}

Answer: B

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32. t_{2g} orbitals in octahedral complexes are

A. d_{xy}, d_{yz}, d_{xz}

B. $d_{xy}, d_{x^2-y^2}, d_{z^2}$

C. $d_{x^2-y^2}, d_{z^2}$

D. $d_{xy}, d_{x^2-y^2}$

Answer: A

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33. Correct order of power ligand in spectrochemical series

A. $I^- < Br^- < Cl^-$

B. $C_2O_4^{2-} < H_2O < NCS^-$

C. $NH_3 < CN^- < CO$

D. All of these

Answer: D

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34. Which of the following statement are incorrect ?

A. If $\Delta_0 < P$, high spin state in more stable

B. NO_2 is a very strong ligand

C. Colour of a complex depends upon nature of metal ion only

D. $\Delta_0 > \Delta_t$

Answer: C

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35. EAN of $Ni(CO)_4$

A. 28

B. 32

C. 36

D. 38

Answer: C

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36. Which of the following complex is most stable ?

A. $\left[M(NH_3)_6\right]^{2+}$

B. $\left[M(NH_3)_6\right]^{3+}$

C. $\left[M(en)_2(NH_3)_2\right]^{3+}$

D. $\left[M(en)_3\right]^{3+}$

Answer: D

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37. According to crystal filed theory , five d-orbitals of an octahedral complex split to give

A. Two orbitals with lower energy and three orbitals with higher energy

B. Three orbitals with lower energy and two orbitals with higher energy

C. One orbitals with lower energy and four orbitals with higher energy

D. Four orbitals with lower energy and one orbital with higher energy

Answer: B

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38. The hardness of water is measured by

A. EDTA method

B. Distillation method

C. Conductivity method

D. All of these

Answer: D

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39. Which reagent can be used to identify Ni^{2+} ion ?

A. Resorcinol

B. Dimethyl glyoxime

C. Diphenyl benzidine

D. Potassium ferrocyanide

Answer: B

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40. Which of the following is not organometallic complex ?

A. Grignard reagent

B. Ferrocene

C. Trans-platin

D. Diethyl zinc

Answer: C

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41. Wilkinsion catalyst is

A. $NiCl_4$

B. $(Ph_3P)_3RhCl$

C. $AlCl_3 + TiCl_4$

D. $Fe(CO)_5$

Answer: B

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42. Antitumor reagent is

A. Ferrocene

B. Zeigler-natta salt

C. $\left[Ag(CN)_2\right]^-$

D. cis-platin

Answer: D

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43. Stability of the complex depends on

A. Oxidation state

B. Nature of ligand

C. Geometry of complex

D. All of these

Answer: D

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44. Which of the following system has maximum number of unpaired electrons ?

A. d^4(octahedral , low spin)

B. d^6(tetrahedral , high spin)

C. d^6(octahedral , low spin)

D. d^9(octahedral)

Answer: B

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45. π bonding is not involved in

A. Ferrocene

B. Dibenzene chromium

C. Zeise's slat

D. Grignard reagent

Answer: D

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Assignment Section B Objective Type Questions One Option Is Correct

1. Which complex ion has cis and trans isomer ?

A. $[PdCl_3NH_3]^-$

B. $\left[Pd(CN)_5NH_3\right]^-$

C. $\left[PtCl_2(CN)_2\right]^{2-}$

D. $\left[Pt(C_2O_4)_2\right]^{2-}$

Answer: C

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2. Which of the following divalent metal ion form the most stable complexes ?

A. Mn^{2+}

B. Fe^{2+}

C. Ni^{2+}

D. Cu^{2+}

Answer: D

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3. A six coordination complex of formula $CrCl_3 \cdot 6H_2O$ has green colour. A 0.1 M solution of the complex when treated with excess of $AgNO_3$ gave 28.7g of white precipitate. The formula of the complex would be:

A. $\left[Cr(H_2O)_6\right]Cl_3$

B. $\left[Cr(H_2O)_5Cl\right]Cl_2.\ H_2O$

C. $\left[Cr(H_2O)_4Cl_2\right]Cl.2H_2O$

D. $\left[Cr(H_2O)_3Cl_3\right].3H_2O$

Answer: B

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4. If excess of $AgNO_3$ solution is added to 100 mL of a 0.024 M solution of dichlorobis (ethylene diamine) cobalt (III) chloride, how many mol of AgCl be precipitated:

A. 0.0012

B. 0.0016

C. 0.0024

D. 0.0048

Answer: C

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5. The complex $[]Ni(CN)_4]^{2-}$ is diamagnetic and the complex $[NiCl_4]^{2-}$ is paramagnetic . What can you conclude about their molecular geometries ?

A. Both complexes have square planar geometries

B. Both complexes have tetrahedral geometries

C. $[NiCl_4]^{2-}$ has a square planar geometry while $[Ni(CN)_4]^{2-}$ has a tetrahedral geometry .

D. $[NiCl_4]^{2-}$ has a tetrahedral geometry while $[Ni(CN)_4]^{2-}$ has a square planar geometry .

Answer: D

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6. How many unpaired electrons are present in the high spin form of $[CoF_6]^{3-}$ complex and which metal orbitals are used in bonding ?

A. 0 unpaired electrons and 4s, 4p and 4d orbitals to give sp^3d^2 hybridisation

B. 4 unpaired electrons and 4s, 4p and 4d orbitals to give sp^3d hybridisation

C. 0 unpaired elctrons and 3d , 4s and 4p orbitals to give d^2sp^3 hybridisation

D. 4 unpaired electrons and 3d, 4s and 4p orbitals to give d^2sp^3 hybridisation .

Answer: B

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7. What is the name of the complex $\left[Ni(H_2O)_4(NH_2CH_2CH_2NH_2)\right]SO_4.5H_2O$ as per IUPAC rules ?

A. Aquaethylenediamine nickel (II) sulphate 1-water

B. Tetraaquaethylenediamine nickel (II) sulphate-5-water

C. Tetraaqua bis (ethylene diamine) nickel (II) sulphate-5-water

D. Tetraaqua bis (ethylene -diamine) nickel (III) sulphate-5-water

Answer: B

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8. Which pair of isomers illustrates the concept of ionisation isomers ?

A. $\left[Cr(SCN)(NH_3)_5\right]^{2+}$ and $\left[Cr(NCS)(NH_3)_5\right]^{2+}$

B. $\left[CoCl(NH_3)_5\right]SO_4$ and $\left[Co(SO_4)(NH_3)_5\right]Cl$

C. $cis\left[PtCl_2(NH_3)_2\right]$ and $\text{trans}\left[PtCl_2(NH_3)_2\right]$

D. $(+)-\left[Co(en)_3\right]^{3+}$ and $(-)-\left[Co(en)_3\right]^{3+}$

Answer: B

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9. Which metal ion is likely to form a square planar complex ion with CN^- ?

A. Cu^{+1}

B. Ag^+

C. Ni^{2+}

D. Zn^{2+}

Answer: C

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10. Which of the given metal ion form high tendency to complex with CO ?

A. Sc^{+3}

B. Ti^{+3}

C. Mn^{+2}

D. Fe^{+2}

Answer: D

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11. Which of the following compounds exhibit geometrical isomer ?

A. $Pt(NH_3)_2Cl_2$

B. $Zn(NH_3)_2Cl_2$

C. $Pt(NH_3)_3Cl$

D. All of these

Answer: A

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12. Effective atomic number of Fe in $Fe_2(CO)_9$ is

A. 35

B. 36

C. 37

D. Cannot be calculated

Answer: B

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13. Which of the following iss mos stable complex ?

A. $\left[Co(NH_3)_6\right]^{+2}$

B. $\left[Co(NH_3)_6\right]^{+3}$

C. $\left[Co(en)_2(NH_3)_2\right]^{+3}$

D. $\left[Co(en)_3\right]^{+3}$

Answer: D

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Assignment Section C Objective Type Questions More Than One Option Are Correct

1. Identify the colourless complexes

A. $Ti(NO_3)_4$

B. $\left[Cu(NCCH_3)_4\right]^+ BF_4^-$

C. $\left[Cr(NH_3)_6\right]Cl_3$

D. $K_3[VF_6]$

Answer: A::B

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2. Identify the incorrect statements about $\left[Cu(NH_3)_4\right]^{2+}$

A. The complex is tetrahedral

B. The complex is square planar

C. Cu^{2+} in the complex is dsp^2 hybridised

D. Cu^{2+} in the complex is sp^2 hybridised

Answer: A::C

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3. $\left[Co(NH_3)_5NO_2\right]SO_4$ shows

A. Ionisation isomerism

B. Coordination isomerism

C. Linkage isomerism

D. Position isomerism

Answer: A::C

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4. Which complexes show geometrical isomerism ?

A. Tetrahedral

B. Octahedral

C. Square planar

D. Linear

Answer: B::C

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5. An example of coordination isomerism is

A. $\left[Cr(H_2O)_6\right]Cl_3$ and $\left[Cr(H_2O)_5Cl\right]Cl_2, H_2O$

B. $\left[Co(NH_3)_6\right]\left[Cr(CN)_6\right]$ and $\left[Cr(NH_3)_6\right]\left[Co(CN)_6\right]$

C. $\left[Pt(NH_3)_4Cl_2\right]$ and $\left[Pt(NH_3)_2Cl_4\right]$

D. $\left[Co(NH_3)_5Br\right]SO_4$ and $\left[Co(NH_3)_5SO_4\right]Br$

Answer: B

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6. Which of the following compounds is paramagnetic ?

A. $\left[Ni(CO)_4\right]$

B. $K_2\left[Ni(CN)_4\right]$

C. $K_3[CoF_6]$

D. $\left[Cr(NH_3)_6\right]Cl_3$

Answer: C::D

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7. $\left[Cr(CN)_6\right]\left[Co(NH_3)_6\right]$ contains

A. Cationic complex

B. Anionic complex

C. Neutral ligands

D. Anionic ligands

Answer: A::B::C::D

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8. Other theories explaining the bonding in coordination compounds are

A. Ligand field theory

B. Molecular orbital theory

C. VSEPR theory

D. Atomic orbital theory

Answer: A::B

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9. On mixing aqueous solution of copper sulphates with aqueous solution of ammonia a deep blue coloured solution is obtained. Choose the correct options :

A. The blue coloured solution shows presence of Cu^{2+} ions

B. The blue coloured solution does not show presence of Cu^{2+} ions

C. The blue coloured solution shows the presence of $\left[Cu(NH_3)_4\right]^{2+}$ ions

D. The blue coloured solution does not show the presence of $\left[Cu(NH_3)_4\right]^{2+}$ ions

Answer: B::C

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10. Which of the following ligands are π acceptor ?

A. NO

B. NO^+

C. PF_3

D. H_2O

Answer: A::B::C

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11. $\left[Co(en)_2NO_2Br\right]Cl$ can exhibit

A. Geometrical isomerism

B. Optical isomerism

C. Linkage isomerism

D. Ionisation isomerism

Answer: A::B::C::D

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12. Which of the following complexes may be coloured due to d-d transition ?

A. $Ni(CO)_4$

B. $K_3\left[Fe(CN)_6\right]$

C. $Cu(H_2O)_4^{+2}$

D. $K_3\left[Cu(CN)_4\right]$

Answer: B::C::D

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13. Stability of the complex may depend on

A. Oxidation state

B. Number of d orbitals in metal ion

C. Nature of ligands

D. Geometry of complex

Answer: A::B::C::D

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14. Which of the following ions favour squae planar geometry ?

A. Au^{+3}

B. Ir^{+}

C. Pt^{+2}

D. Ag^{+2}

Answer: A::B::C

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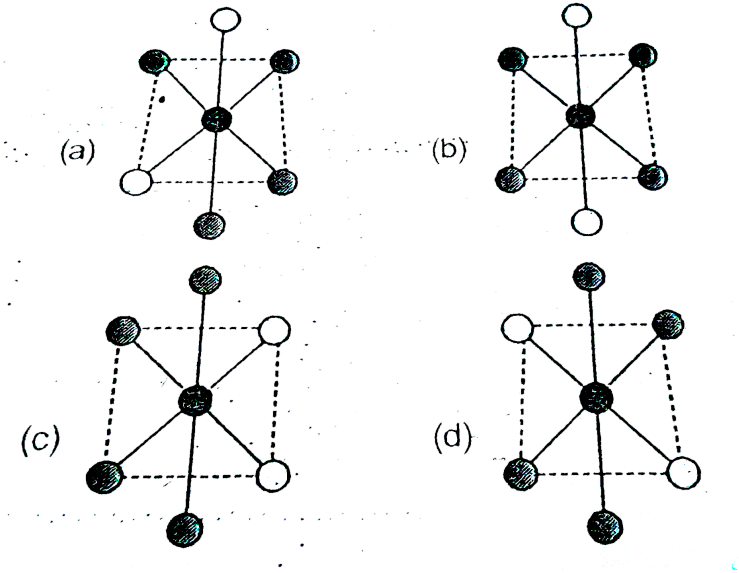
Assignment Section D Linked Comprehension Type Questions Comprehension I

1. Consider the following isomers of $\left[Co(NH_3)_4Br_2\right]^+$. The black sphere represent Co, grey spheres represent NH_3 and unshaded spheres represent Br.



Which of the following are cis-isomers ?

A. Isomers (a) and (b)

B. Isomers (a) and (c)

C. Isomers (b) and (d)

D. Isomers (c) and (d)

Answer: B

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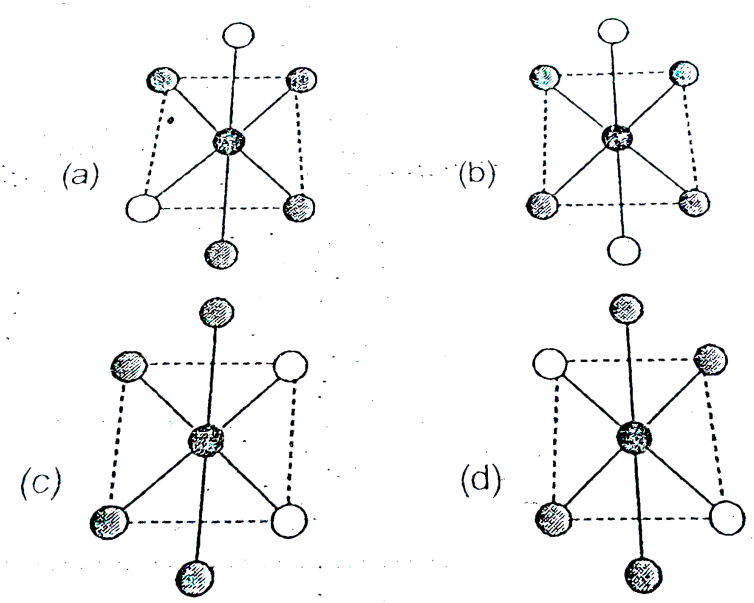
2. Consider the following isomers of $\left[Co(NH_3)_4Br_2\right]^+$. The black sphere represent Co, grey spheres represent NH_3 and unshaded spheres represent Br.



Which of the following are trans-isomers ?

A. Isomers (a) and (b)

B. Isomers (a) and (c)

C. Isomers (b) and (d)

D. Isomers (c) and (d)

Answer: C

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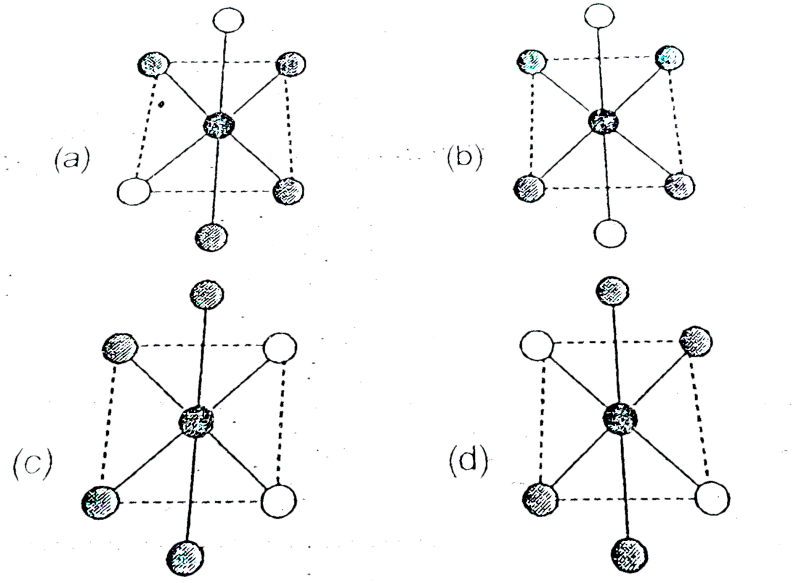
3. Consider the following isomers of $\left[Co(NH_3)_4Br_2\right]^+$. The black sphere represent Co, grey spheres represent NH_3 and unshaded spheres represent Br.



Which structures are identical

A. None of the structures are identical

B. Structre (a) = structure (b) and structure (c) = structure (d)

C. Structre (a) = structure (c) and structure (b) = structure (d)

D. Structre (a) = structure (d) and structure (b) = structure (c)

Answer: C

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Assignment Section D Linked Comprehension Type Questions Comprehension Ii

1. $\underset{[Co(en)_2ClBr]NO_2}{X} \rightarrow \text{Isomer}$

$A \xrightarrow{AgNO_3} \text{Yellow ppt}$B overset(AgNO_(3)) to "White ppt"

C $\rightarrow$ exhibit facial meridonial

How many total structure are possible for compound C ?

A. 2

B. 4

C. 1

D. 3

Answer: B

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2. $\underset{[Co(en)_2ClBr]NO_2}{X} \rightarrow \text{Isomer}$

$A \xrightarrow{AgNO_3} \text{Yellow ppt}$B overset(AgNO_(3)) to "White ppt"

C $\rightarrow$ exhibit facial meridonial

Compound A many show

A. Ionisation isomerism

B. Linkage isomerism

C. Optical isomerism

D. All of these

Answer: D

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Assignment Section E Assertion Reason Type Questions

1. STATEMENT-1: Zeise's salt contain C_2H_4 molecule as one of the ligands

and

STATEMENT-2: Zeise's salt is an organometallic compound .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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2. STATEMENT-1: Oxidation state of Fe in $Fe(CO)_5$ is zero

and

STATEMENT-2: EAN of Fe in its complexes is always 36.

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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3. STATEMENT-1: $\left[Co(NH_3)_3Cl_3\right]$ does not give white ppt . with $AgNO_3$ solution .

and

STATEMENT-2: Chlorine is not present in the ionisable part of the given complex .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: A

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4. STATEMENT-1: Tetrahedral complexes with chiral structure exhibit optical isomerism .

and

STATEMENT-2: They lack plane of symmetry .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: A

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5. STATEMENT-1: The IUPAC name of $K_4\left[Fe(C_2O_4)_3\right]$ is potassiumtrioxalatoferrate (III)

and

STATEMENT-2: Oxalate ion is a bidentate ligand .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: D

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6. STATEMENT-1: Coordination isomerism occurs when both the cations and anions are complexes .

and

STATEMENT-2: Oxidation state of central metal ion in both coordination spheres is always equal.

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: C

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7. STATEMENT-1: The $\left[Ni(en)_3\right]Cl_2$ has higher stability than $\left[Ni(NH_3)_6\right]Cl_2$

and

STATEMENT-2: Ethylene diamine shows chelation with Ni^{+2} ion .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: A

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8. STATEMENT-1: Co^{+2} form octahedral stable complex with excess KCN.

and

STATEMENT-2: CN^{-} is stronger ligand than NH_3 .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: D

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9. STATEMENT-1: CN^- may act as bridging ligand .

and

STATEMENT-2: Lone pair resides on carbon as well as on nitrogen .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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10. STATEMENT-1: $Co(NH_3)_6^{+3}$ is more stable than $\left(Co(en)_2(NH_3)_2\right)^{+3}$

and

STATEMENT-2: Chelation is more in $\left[Co(en)_2(NH_3)_2\right]^{+3}$ than $\left[Co(NH_3)_6\right]^{+3}$

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: D

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11. STATEMENT-1: In square planar complexes , $d_{x^2-y^2}$ is higher in energy than d_{xy}

and

STATEMENT-2: Ligands approach along x and y axis in , $d_{x^2-y^2}$.

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: A

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12. STATEMENT-1: CH_3MgCl is σ organometallic complex .

and

STATEMENT-2: In ether $RMgCl$, co-ordination number of Mg is 6 .

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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13. STATEMENT-1: $Fe(CO)_5$ has trigonal bipyramidal shape .

and

STATEMENT-2: $Fe(CO)_5$ is diamagnetic

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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14. STATEMENT-1: Fe-CN bond length is smaller in $Fe(CN)_6^{-4}$ than $Fe(CN)_6^{-3}$

and

STATEMENT-2: $Fe(CN)_6^{-3}$ is more stable than $Fe(CN)_6^{-4}$

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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15. The questions given below consist of Assertion (A) and Reason (R) . Use the following key to select the correct answer.

Assertion : $Ni(\mathrm{dmg})_2$ is a square planar complex.

Reason : Chelation effect is present in $Ni(\mathrm{dmg})_2$.

A. Statement-1 is True , Statement-2 is True , Statement-2 is a correct explanation for Statement-1

B. Statement-1 is True , Statement-2 is True , Statement-2 is NOT a correct explanation for Statement-1

C. Statement-1 is True , Statement-2 is False

D. Statement-1 is False , Statement-2 is True

Answer: B

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Assignment Section F Matrix Match Type Questions

1. Match the column

Column I	Column II
(A) Glycinate ion	(p) Bidentate
(B) EDTA	(q) Hexadentate
(C) Oxalate	(r) Monodentate
(D) Sulphate	(s) Lewis base

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2. Match the given compound in column I to the properties given in column II

Column I	Column II
A) $[CuCl_4]^{-2}$	(p) sp^3 hybridisation
B) $[Pt(NH_3)_4][PtCl_4]$	(q) dsp^2 hybridisation
C) $Fe_2(CO)_9$	(r) Paramagnetic
D) $[Cu(NH_3)_4]^{+2}$	(s) Diamagnetic
	(t) Metal - metal bond

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3. Match the compound given in column I to the properties given in column II

Column I	Column II
(A) $[Co(en)_2ClBr]^+$	(p) Geometrical isomerism
(B) $[Pt(NH_3)_2Cl_2]$	(q) Optical isomerism
(C) $[Cu(NH_3)_6]^{+2}$	(r) All bond length are not equal
(D) $[Ni(dmg)_2]$	(s) Chelation effect is present
	(t) Hydrogen bonding is present in complex

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Assignment Section G Integer Answer Type Questions

1. How many sp^3 hybridised atoms are there in one molecule of $CuSO_4.5H_2O$?

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2. How many type of geometrical isomers are possible for $[M(NH_3)BrCl(H_2O)]$, where M is Pt^{+2} ?

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3. The coordination number of Fe in $\left[Fe\left(\eta^5 - C_5H_5\right)_2\right]$ is 2x . Then x will be _____

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4. How many geometrical isomers are possible for $[Zn(NH_3)ClBrPPh_3]^-$?

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5. How many geometrical isomers are possible for $MA_2B_2C_2$?

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6. How many rings are present in $[MEDTA]^{+n}$?

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7. How many maximum atoms are present in one plane of $\left[PtCl_3\left(n^2 - C_2H_4\right)\right]^-$?

A. 8

B. 2

C. 5

D. 4

Answer: 4

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8. How many metal-metal bonds are present in $Co_4(CO)_{12}$?

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Assignment Section H Multiple True False Type Questions

1. STATEMENT-1: Tetrahedral complexes are always high spin complexes .

STATEMENT-2: Crystal field splitting energy in tetrahedral complexes is 2/3 of the Δ_0 (crystal field splitting energy in octahedral complexes).

STATEMENT-3: Tetrahedral complex $[MABCD]^{\pm n}$ is optically active .

A. TTT

B. TFT

C. FTF

D. TTF

Answer: 2

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2. STATEMENT-1: CO is stronger ligand than CN^-

STATEMENT-2: CO and CN^- both show synergic bonding with metal .

STATEMENT-3: CO and N_2 are isoelectronic ligands but N_2 is a weaker ligand than CO but stronger than NH_3 .

A. TFT

B. TTF

C. FFT

D. FTT

Answer: 2

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3. STATEMENT-1: In $LiAlH_4$, Al is sp^3 hybridised .

STATEMENT-2: $LiAlH_4$ is a good reducing agent .

STATEMENT-3: $LiAlH_4$ complex is unstable in water .

A. TTT

B. TTF

C. TFF

D. FTT

Answer: 1

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4. STATEMENT-1: In $\left[Cr(NH_3)_6\right]Cl_3$, the Werner primary valency is 3 .

STATEMENT-2: $\left[Cr(NH_3)_6\right]Cl_3$ is paramagnetic .

STATEMENT-3: $\left[Co(NH_3)_6\right]^{+3}$ is a low spin complex

A. TFT

B. TTT

C. FTT

D. TFF

Answer: 2

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5. STATEMENT-1: $[M(en)Cl_2Br_2]$ is optically active complex .

STATEMENT-2: en is a bidentate ligand .

STATEMENT-3: In $K\left[Cu(CN)_2\right]$, co-ordination number of Cu is 3 .

A. TFT

B. TTT

C. TFF

D. FTT

Answer: 4

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Assignment Section I Subjective Type Questions

1. Write the formula of each of the following complexes .

(i) Ammonium hepta fluorozirconate (IV)

(ii) Diamminesilver (I) hexacyanoferrate (II)

(III) Dichlorobis (ethylenediamine) chromium (III)

tetrachloropalladate (II)

(iv) Dicyanobis (ethylenediamine) cobal (III) chlorate

(v) Potassium hexafluoronickelate (IV)

(iv) Bromotriammineplatinum (II) nitrite

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2. Name the following complexes according to the IUPAC system of nomenclature

(i) $\left[Co(NH_3)_4(H_2O)Br\right](NO_3)_2$

(ii) $Na\left[Au(CN)_2\right]$

(iii) $Na_3\left[Fe(C_2O_4)_3\right]$

(iv) $\left[Co(en)_3[Cl_3\right.$

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3. Arrange the following compounds in order of increasing molar conductivity

(a) $K\left[Co(NH_3)_2(NO_2\_(4)\right]$

(b) $\left[Cr(NH_3)_3(NO_2)_3\right]$

(c) $\left[Cr(NH_3)_5(NO_2)\right]_3\left[Co(NO_2)_6\right]_2$

(d) $Mg\left[Cr(NH_3)(NO_2)_5\right]$

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4. Account for the following

(i) $Co(II)$ is stable in aqueous solution but in the presence of strong ligand and air , it can get oxidized to $Co(II)$.

(ii) $\left[Ni(CN)_4\right]^{2-}$ is square planar and diamagnetic whereas $[NiCl_4]^{2-}$ is tetrahedral and paramagnetic .

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5. $FeSO_4$ solution mixed with $(NH_4)_2SO_4$ solution is $1:1$ molar ratio gives the test of Fe^{2+} ion but $CuSO_4$ solution mixed with aqueous ammonia in $1:4$ molar ratio does not give the test of Cu^{2+} ion. Explain why?

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6. (a) Square planar complexes with coordination number four exhibit geometrical isomerism whereas tetrahedral complexes do not , why ?

(b) Three geometrical isomers of the square planar complex $[Pt(NH_3)(H_2O)(py)(NO_2)]^+$ are possible . What are they ?

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7. A, B and C are three complexes of chromium(III) with the empirical formula $H_{12}O_6C_{13}Cr$ All the three complexes not react

with concentrated H_2SO_4 whereas complexes B and C lose $6.75\,\%$ and $13.5\,\%$ of their original mass respectively, on treatment on treatment with conectrated H_2SO_4 Identify A, B and C.

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8. Classify each of the following complexes as either high or low spin . Explain your answers.

(i)

$\left[Co(H_2O)_6\right]^{2+}\mu = 3.87B.M.$ $\left[Co(CN)_6\right]^{3-}\mu = 0.0B.M.$

(ii)

$\left[Fe(NO_2)_6\right]^{4-}\mu = 0.0B.M.$ $\left[Fe(H_2O)_6\right]^{3+}\mu = 5.94B.M.$

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9. Write the $IUPAC$ nomenclature of the given complex along with its hybridisation and structure

$K_2\left[Cr(NO)(NH_3)(CN)_4\right], \mu = 1.73.\ BM$.

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10. $NiCI_2$ in the presence of dimethy1 glyoxime(DMG) gives a complex which precipitates in the presence of NH_4OH giving a bright red colour .

(a) Draw its structure and show H bonding

(b) Give the oxidation state of Ni and its hybridisation

(c) Predict whether it is paramagnetic or dimagnetic .

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Assignment Section J Aakash Challenger Questions

1. For Ag^+ metal ion, correct sequence regarding ligand strength is

A. $F^- > Cl^- > Br^- > I^-$

B. $I^- > Br^- > Cl^- > F^-$

C. $Cl^- > Br^- > F^- > I^-$

D. $F^- > Br^- > I^- > Cl^-$

Answer: B

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2. Choose the correct statement regarding complex CuF_6^{-4}

A. All Cu-F bond lenghts are equal

B. It is paramagnetic

C. It is diamagnetic

D. Both (1) & (2)

Answer: B

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3. Which of the following ligands may be flexidentate ?

A. EDTA

B. CO_3^{-2}

C. NO_3^-

D. All of these

Answer: D

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4. In which complex C-O bond length is maximum ?

A. $V(CO)_6^-$

B. $Cr(CO)_6$

C. $Mn(CO)_6^+$

D. $Fe(CO)_6^{+2}$

Answer: A

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5. Choose the incorrect regarding stability

(a) $\left[Fe(\text{phen})_3\right]^{+2} > \left[Fe(\text{phen})_3\right]^{+3}$

(b) $\left[Fe(CN)_6\right]^{-4} > \left[Fe(CN)_6\right]^{-3}$

(c) $Fe(\text{dipy})_3^{+3} > Fe(\text{dipy})_3^{+2}$

A. a,b

B. b,c

C. a,c

D. a,b,c

Answer: A

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6. Choose the correct statement regarding complex CuF_6^{-4}

A. Chelation always increase stability

B. CFSE have strong effect on stability

C. $Fe(\text{dipy})_3^{+3}$ is unstable

D. All of these

Answer: B

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7. Strongest C-O bond is present in

A. $Fe(CO)_5$

B. $Mn(CO)_6^+$

C. $Cr(CO)_6$

D. $V(CO)_6^-$

Answer: B

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8. $(MA_2B_2C_2)^{+n}$ can exhibit

A. Geometrical isomerism

B. Optical isomerism

C. Ionisation isomerism

D. Both (1) & (2)

Answer: D

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9. The hybridisation of Co in $(CoF_6)^{-2}$ is

A. sp^3d^2

B. d^2sp^3

C. sp^3d^3

D. d^3sp^3

Answer: B

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10. Which of the following compound may be optical active ?

A. $Co(en)_2Cl_2$

B. $[RhClBrNH_3PH_3]^-$

C. $Cu(en)_2Cl_2$

D. All of these

Answer: A

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